



# Exploring and Visualizing A-Train Instrument Data

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Based on the NASA funded ACCESS Project: A-Train Data Depot: Integrating Atmospheric Measurements Along the A-Train Tracks Utilizing Data from the Aqua, CloudSat and CALIPSO Missions

## Abstract

The goal of the A-Train Data Depot (ATDD) is to enable free transfer of remotely located A-Train data so that they are combined to create a consolidated vertical view of the Earth's Atmosphere along the A-Train tracks. The innovative approach of analyzing and visualizing atmospheric profiles along the platforms track (i.e., time) is accomplished by the ATDDs Giovanni data analysis and visualization tool. Through Giovanni, researchers can bring together data from the Aqua, CloudSat, CALIPSO, Aura, and POLDER missions, for a specific time and location of interest.

This presentation shows the power of Giovanni by illustrating how it aids A-Train science and research. Giovanni provides the capability of creating co-located profile images, modifying horizontal and vertical axis range, and selecting data and dynamic color range. Vertical 'curtains' and two dimensional strip plots, co-located along the CloudSat reference track, can be co-plotted. Images and subplots data produced in each analysis run may be downloaded. Users truly can explore and discover data specific to their needs prior to ever transferring data to their analysis tools.

## New Data Products in the A-Train Data Depot

Recently, several products were added into the ATDD for data visualization and access:

- OMI/Aura Effective Cloud Pressure and Fraction (Rotational Raman) (PI: Joanna Joiner)
- OMI/Aura Effective Cloud Pressure and Fraction (O2-O2 Absorption) (PI: Pepijn Veefkind)
- OMI/Aura Aerosol Extinction and Absorption Optical Depth (PI: Omar Torres)
- OMI/Aura Ozone, TOMS-like Algorithm: Aerosol Index, Reflectivity, O3 (PI: P. K. Bhartia)
- CloudSat product, Radar-only liquid/ice water content (PI Richard Austin)
  - Radar-only (RO) Liquid Effective Radius
  - Radar-only (RO) Ice Effective Radius
  - Radar-only (RO) Liquid Water Content
  - Radar-only (RO) Ice Water Content
  - Radar-only (RO) Liquid Water Path
  - Radar-only (RO) Ice Water Path

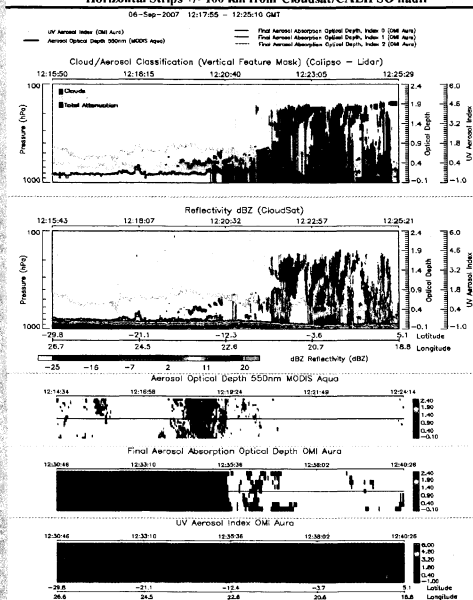
PARASOL products being prototyped (See below)  
New CALIPSO profile parameters are in test, as well

## What can the A-Train Data Depot Do For You

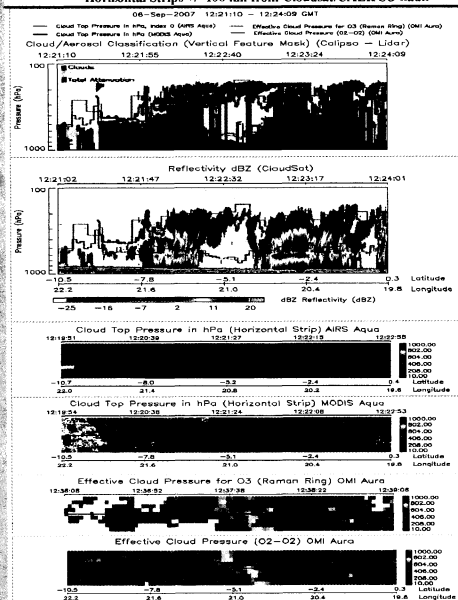
The A-Train Data Depot (ATDD) has been operational for more than a year. (<http://disc.gsfc.nasa.gov/atdd/>)

- Provide access to A-Train datasets from one portal
- Provide user friendly, quick data visualization and exploration to support science data discovery.
- Perform much of the work each individual researchers would be spending valuable resources on:
  - User specified subsetting out of large volumes of data, just the information nearest the A-Train path.
  - Accessing remote heterogeneous datasets and subsets for convenient download
  - Co-registering datasets of different formats, resolutions, and scales onto common grids
  - Performing these functions on specific user requested data of interest.
  - Output formats include: HDF4
- Provide a virtual data portal/center that processes, archives, provides access, visualizes, analyzes and correlates distributed atmosphere measurements from various A-Train instruments along A-Train tracks.

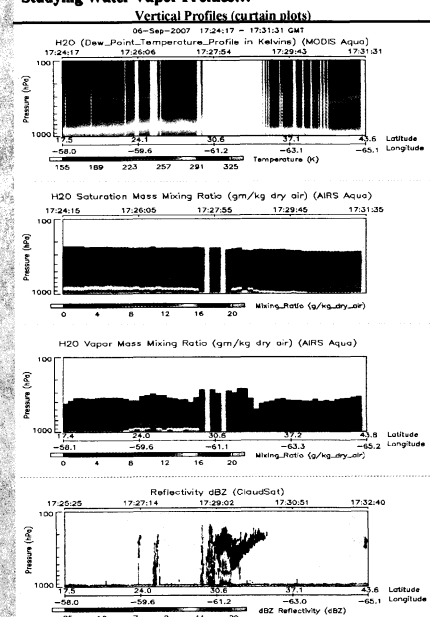
## Studying Aerosols... Vertical Profiles (curtain plots) & Horizontal Strips +/- 100 km from CloudSat/CALIPSO nadir



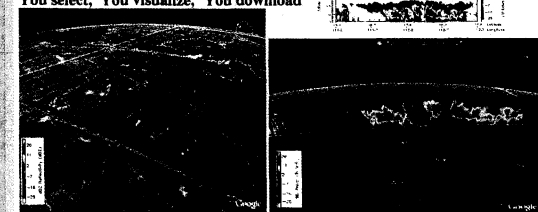
## Studying Clouds... Vertical Profiles (curtain plots) & Horizontal Strips +/- 100 km from CloudSat/CALIPSO nadir



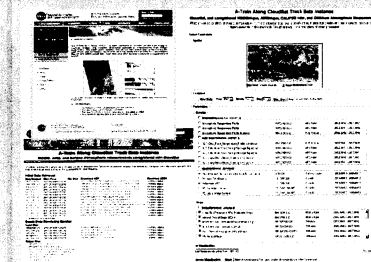
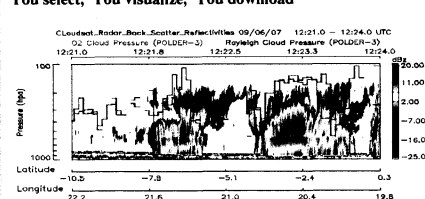
## Studying Water Vapor Profiles...



## PROTOTYPE: Google Earth - Exploring A-Train data in 3 dimensions: You select, You visualize, You download



## PROTOTYPE: POLDER data in the ATDD - Co-registering POLDER data with CloudSat... and others to follow: You select, You visualize, You download



## The A-Train Instrument Principal Investigators

Aqua - AIRS/AMU	Dr. Moustafa Chahine, NASA JPL
HSB	
Aqua - AMSR-E	Dr. Roy Spencer, UAH
Aqua - CERES	Dr. Akin Shubata, JAXA
Aqua - MODIS	Dr. Wielicki, NASA LaRC
	Dr. Vincent Salomonson, U. of Utah, NASA GSFC (emeritus)
Aura - HIRDLS	Dr. John Gille, UC, NCAR
Aura - MLS	Dr. John Barnett, Oxford
Aura - OMI	Dr. Nathaniel Livesey, NASA JPL
	Dr. Pieter Levelt, KNMI
	Dr. Johanna Tamminen, FMI
	Dr. P.K. Bhartia, NASA GSFC
	Dr. Reinhard Beer, NASA JPL
Aura - TES	
CALIPSO	Dr. Dave Winker, NASA LaRC
CloudSat	Dr. Graeme Stephens, CSU
Glory	Dr. Michael Mishchenko, Project Scientist, NASA GISS
OCO	Dr. David Crisp, NASA JPL
Parasol	Dr. Didier Tanré, LOA

## Coming ...

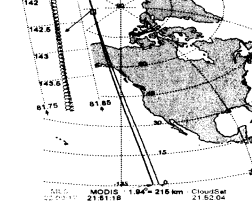
- Polder data operational
- AMSR-E, TES, HIRDLS data
- NO2, CO2, other products
- User Selected Ranges
- MLS data along the CloudSat track
- UV aerosol index background on the orbit picker

A-Train is actually comprised of 2 tracks.

Track 1: CloudSat, CALIPSO

Track 2: MLS, TES

Both Tracks: MODIS, AIRS, OMI

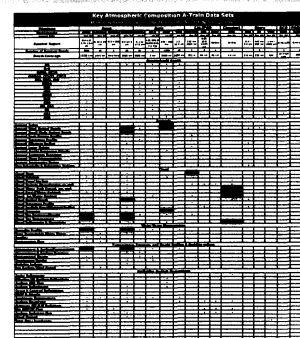


## Currently Accessible Products

- Cloud Products -**
  - CALIPSO - Cloud/Aerosol Classification
  - CloudSat - Received Echo Powers
  - CloudSat - Reflectivity dBZ
  - CloudSat - RO Ice Water Content (new)
  - CloudSat - RO Ice Water Path (new)
  - CloudSat - RO Liquid Water Content (new)
  - CloudSat - RO Liquid Water Path (new)
- Temperature Products -**
  - MODIS - Atmospheric Temperature Profile
  - AIRS - Atmospheric Temperature Profile
- Water Vapor Products -**
  - MODIS - H2O (Dew Point Temperature Profile)
  - AIRS - H2O Saturation Mass Mixing Ratio
  - AIRS - H2O Vapor Mass Mixing Ratio
- Horizontal Strips (+/- 100 km from CloudSat path) or line plot overlays upon vertical profile**
  - OMI - Effective Cloud Pressure for O3 (RR)
  - OMI - Effective Cloud Pressure (O2-O2)
  - OMI - Final Aerosol Absorption Optical Depth (new)
  - OMI - UV Aerosol Index (new)
  - MODIS - Aerosol Optical Depth 550nm
  - MODIS - Aerosol Fine Mode Fraction 550nm
  - MODIS - Cloud Optical Thickness
  - MODIS - Cloud Top Pressure
  - MODIS - Cloud Top Temperature
  - AIRS - Cloud Top Pressure
  - AIRS - Cloud Top Temperature
  - AIRS - Total Cloud Liquid Water

## 2007 Metrics (thus far)

- Number of Products Provided: 4,410,322
- Number of Product Types Available: 26
- Volume of Data Distributed: 7256 GB
- Volume of Data Available: ~14 TB



**EXPLORING AND VISUALIZING A-TRAIN INSTRUMENT DATA**  
**KEMPLER S1, LEPTOUKH G1, SMITH P1, STEPHENS G2, SAVTCHENKO A1,**  
**BERRICK S1,**  
**WINKER D3, REINKE D2**

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Fort Collins, USA. (3) NASA's  
Langley Research Center, Hampton, USA.

**Abstract Keyword 1 (Mandatory):** Aerosol/clouds/radiation/precipitation interactions

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The succession of US and international satellites that follow each other in close succession, known as the A-Train, affords an opportunity to atmospheric researchers that no single platform could provide: Increasing the number of observations at any given geographic location... a more complete "virtual science platform". (Kelly, 2003) However, vertically and horizontally, co-registering and regridding datasets from independently developed missions, Aqua, Calipso, Cloudsat, Parosol, and Aura, so that they can be inter-compared can be daunting to some, and may be repeated by many. Scientists will individually spend much of their time and resources acquiring A-Train datasets of interest residing at various locations, developing algorithms to match up and graph datasets along the A-Train track, and search through large amounts of data for areas and/or phenomena of interest. The aggregate amount of effort that can be expended on repeating pre-science tasks could climb into the tens of millions of dollars.

The goal of the A-Train Data Depot (ATDD) is to enable free movement of remotely located A-Train data so that they are combined to create a consolidated vertical view of the Earth's Atmosphere along the A-Train tracks. The innovative approach of analyzing and visualizing atmospheric profiles along the platforms track (i.e., time) is accomplished by through the ATDDs Giovanni data analysis and visualization tool. Giovanni brings together data from Aqua (MODIS, AIRS, AMSR-E), Cloudsat (cloud profiling radar) and Calipso (CALIOP, IIR), as well as the Aura (OMI, MLS, HIRDLS, TES) to create a consolidated vertical view of the Earth's Atmosphere along the A-Train tracks. This easy to learn and use exploration tool will allow users to create vertical profiles of any desired A-Train dataset, for any given time of choice.

This presentation shows the power of Giovanni by describing and illustrating how this tool facilitates and aids A-Train science and research. A web based display system Giovanni provides users with the capability of creating co-located profile images of temperature and humidity data from the MODIS, MLS and AIRS instruments for a user specified time and spatial area. In addition, Cloud and Aerosol profiles may also be displayed for the Cloudsat and Calipso instruments. The ability to modify horizontal and vertical axis range, data range and dynamic color range is also provided. Two dimensional strip plots of MODIS, AIRS, OMI and POLDER parameters, co-located along the Cloudsat reference track, can also be plotted along with the Cloudsat cloud profiling data. Center swath pixels for the same parameters can also be shown as line plots overlaying the Cloudsat or Calipso profile images. Images and subsetting data produced in each analysis run may be downloaded. Users truly can explore and discover data specific to their needs prior to ever transferring data to their analysis tools.